Water and Wastewater Utility Climate Change Mitigation and Adaptation Efforts in EPA Region 3

In the Mid-Atlantic, water and wastewater utilities are responding to threats from climate change by adopting mitigation and adaptation measures to reduce greenhouse gas emissions and improve resiliency. **Mitigation measures** are actions to reduce a utility's contribution to climate change, generally through the reduction of greenhouse gas emissions. **Adaptation measures** are the physical changes that utilities are making to their plants and infrastructure to protect against threats (e.g., floods, extreme weather) resulting from climate change. Both mitigation and adaptation actions can establish a utility as an environmental steward in its community, reduce energy costs, and improve reliability. The following examples highlight the range of adaptation and mitigation efforts already underway at several utilities in EPA Region 3.

Rivanna Water and Sewer Authority

Charlottesville, VA
30,210 water and sewer customers
(Website: www.rivanna.org/home.htm; phone: 434-977-2970)

Mitigation: Reduce energy using a combined heat power (CHP) system running on digester gas
Adaptation: Reuse non-potable water

As part of the upgrade from a conventional activated sludge plant to a five-stage enhanced nutrient removal (ENR) process, the Rivanna Water and Sewer Authority (RWSA) selected improvements for the Moores Creek wastewater treatment plant (WWTP) to reduce energy use, save money, and lower greenhouse gas emissions. After comparing four possible scenarios for upgrading the WWTP, RWSA installed a combined heat and power (CHP) system that runs off of digester gas, produced via anaerobic digestion of bio solids, that is capable of generating electricity which can power 25-30 percent of the plant's needs.

The new CHP system replaced a less efficient system that relied on engine-driven blowers supplemented by natural gas to generate sufficient hot water for heating the digesters. Since operation of the CHP system in 2011, the WWTP has achieved significant savings by avoiding purchases of natural gas and electricity. Natural gas purchases were reduced from 13.7 million Btu/day in 2009-2010 to 1.9 million Btu/day. Electricity use also decreased from 690 kWh per million liters of wastewater treated to 560 kWh per million liters treated.

High efficiency centrifugal blowers (electric) installed as part of the upgrades to the Moores Creek Wastewater Plant.

Prior to the upgrades, most of the equipment in use at the Moores Creek WWTP was close to thirty years in age or beyond. A benefit to renovating and replacing the existing equipment is that the wastewater treatment facility has become more efficient and reliable in its service to the City and County.

Also, to maximize conservation and preserve the existing drinking water supply, the WWTP recycles a portion of treated effluent and uses it for multiple non-drinking uses. This has resulted in over a 1.5 million gallons annual savings of potable drinking water (source: http://www.rivanna.org/moorescreek/index.htm).

American Water

Maryland, Virginia, Delaware, Pennsylvania
14 million customers in 30+ states and two Canadian provinces
(Website: www.amwater.com; phone: 856-346-8200)

Mitigation: Reduce energy use by improving pump efficiencies

American Water (AW) is an investor-owned water and wastewater utility company that owns and operates over 800 water and wastewater systems across United States and Canada. AW has been proactive in achieving greenhouse gas (GHG) reductions and energy efficiency across its systems. A GHG inventory conducted by AW showed 92 percent of its carbon footprint originated from electricity use. The main contributor (95 percent) to electricity use for AW is water and wastewater pumping. In response, AW adopted a company-wide "Pump Efficiency Initiative" to identify opportunities to reduce energy consumption and GHG emissions.

Variable motor drive technology automatically adjusts the speed of equipment based on need.

The goal of AW's initiative is to increase pumping efficiency by 8.4% and to decrease GHG emissions by 7.5%. AW's pump efficiency initiative is scheduled to take place over six years and cost a total of $80 million. In addition to energy savings from upgrading pumps, the program is also expected to reduce its GHGe (GHG equivalent) per million gallons (MG) of water delivered by 16% (source: http://amwater.com/corporate-responsibility/environmental-sustainability/climate-change-and-energy-management/reducing-energy-use.html).

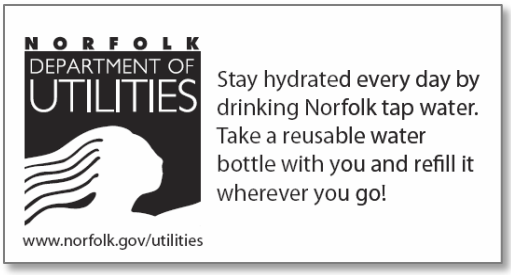
Norfolk Department of Utilities: Tapit Program

Norfolk, VA
850,000 DW and 240,000 WW customers
(Website: www.norfolk.gov; phone: 757-664-6700)

Mitigation: Reduce waste and GHG emissions from disposable plastic bottles

Plastic bottles are a soure of landfill waste and use both energy (thereby creating GHG emissions) and water to manufacture. Tap water is a only a faction of the cost of bottled water and does not contribute to landfill waste. To increase the use of resuable water bottles, the Norfolk Department of Utilities is promoting the Tapit Program to local shops and eateries in Norfolk. Stores participating in Tapit provide free tap water refills to people using reusable water bottles.

Tapit is a nationwide program that allows communities to create a water bottle refilling network of shops and eateries to make water refills available to people with reusable bottles. In the Norfolk area, residents and vistors can find a participating business by using the Tapit iPhone app, the Tapit website, or the Norfolk Department of Utilities website. Participating restaurants and shops can also place Tapit stickers on their windows to show their participation in the program. There are currently 20 businesses in Norfolk participating in the Tapit program.



Norfolk Department of Utilities outreach message promoting the use of reusable water bottles.

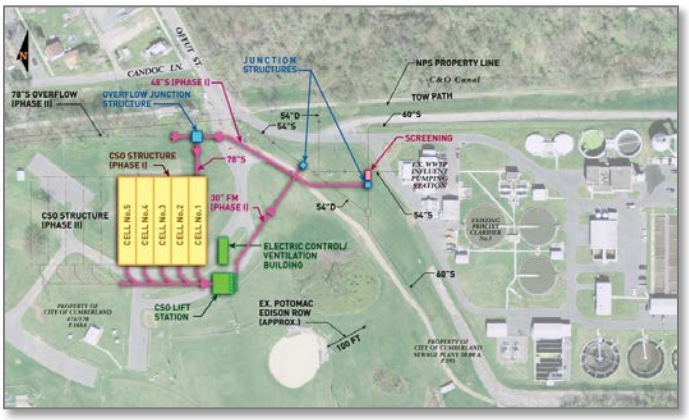
By promoting Tapit, the Norfolk Department of Utilities is helping residents save money and help reduce pollution and GHG emissions associated with the manufacture, transportation, and disposal of plastic water bottles. The program also offers residents in the Norfolk area a way to reduce their contribution to waste from disposable plastic water bottles (source: http://www.norfolk.gov/index.aspx?nid=1558).

City of Cumberland CSO Storage Facility

Cumberland, MD
21,518 residents
(Website: www.ci.cumberland.md.us; phone: 301-759-6620)

Adaptation: Prevent and treat combined sewer overflows with new storage facility

The City of Cumberland public utilities is undertaking improvements to its combined sewer system to correct a capacity problem that has resulted in backups. The proposed combined sewer overflows (CSOs) storage facility near the Cumberland wastewater treatment plant is designed to capture 80% of the community's overflows and provide treatment at the WWTP before discharging into the Potomac River. The project will reduce overflows of untreated wastewater with bacteria and other pollutants to the Potomac River and ultimately the Chesapeake Bay.



The proposed CSO Storage Facility in the City of Cumberland to prevent sewer overflows at the wastewater treatment plant.

The City's existing sewer system includes a network of collector and interceptor sewers, over 98 miles in length and ranging in size from eight to 60 inches. The collector sewers are usually combined; carrying both storm water and wastewater, although some areas of Cumberland have separate storm and sanitary systems. Generally, where the combined sewers enter the interceptor sewers, diversion manholes and regulating chambers are located. These points are the source of the City's CSOs and were designed to relieve the high flow that occurs during heavy precipitation events. Funding for planning and design came from a $1,008,835 Chesapeake Bay Water Quality Project Funds grant to the City of Cumberland, in addition to a previous $300,000 grant (source: http://www.ci.cumberland.md.us/new_site/index.php/contents/view/331).

City of Crisfield Wastewater Treatment Facility

Crisfield, MD
2,888 WW customers
(Website: www.cityofcrisfield-md.gov; phone: 410- 968-1333)

Mitigation: Offset WWTP energy use with wind power

The City of Crisfield is planning a 750 mega watt (MW) wind turbine to provide electricity at its WWTP. The wind turbine is expected to generate more than enough electricity to power the treatment plant and save the city an estimated $150,000 to $200,000 a year in electricity costs. The city can also sell excess electricity produced by the wind turbine back to the grid.

A 750 MW wind turbine was selected by Crisfield to supply electricity at its wastewater treatment plant

The plan to install a wind turbine follows the city's upgrades to its WWTP, which included construction of a biological nutrient removal (BNR) treatment system to reduce the nutrients discharged into the Chesapeake Bay. The treatment plant upgrades were aimed at protecting the Chesapeake Bay and the economically important fish and shellfish industry it supports. Excessive nutrients, such as nitrogen, in coastal waters can disrupt aquatic life and promote algal blooms that starve water of oxygen and kill fish.

After the treatment plant upgraded to the BNR system, the electricity bill rose from $13,000 per month to $20,000 per month. The proposed wind power project is expected to offset the additional energy costs for the WWTP. The project is funded through a $453,000 green loan and a $3.17 million green grant in the form of loan forgiveness from the Water Quality State Revolving Loan Fund (source: http://www.delmarvanow.com/article/20130311/SH/303110014/State-OKs-funds-Crisfield-wind-turbine).

Sharptown Wastewater Treatment Plant

Sharptown, MD
300 households
(Website: www.townofsharptown.org; phone: 410-883-3767)

Mitigation: Reduce energy use through new pumps and variable frequency drives (VFDs)

The influent pump station pumps at Sharptown's wastewater treatment plant were over 30 years old, leading to decreased reliability and efficiency. The decreased efficiency is attributed to the wear and corrosion found on the existing pumps, which resulted in increased energy costs for the plant.

When it came time to upgrade the facility's outdated equipment, Sharptown incorporated energy efficient elements into the design of the wastewater treatment plant pump station upgrades. These energy saving elements allowed the utility to achieve a substantial cost savings in operational expenses, as well as decreased negative environmental impacts. The upgrades to the WWTP pump station included upgrading two existing influent pumps to high efficiency pumps with an improved power factor; and installing VFDs on the pumps to reduce energy consumption.

Efficient influent pumps and VFDs at Sharptown's Wastewater Treatment Plant

Since the pumps at the WWTP receive variable flows throughout a 24-hour cycle, they are well suited for VFDs. VFDs can increase system energy efficiency by providing a means to reduce the motor speed of variable torque loads.

Replacing the pumps is estimated to result in an energy savings of 43% compared to existing outdated pumps, and save $1,872 annually on maintenance costs. The energy savings by using VFDs on two five-horsepower pumps running for eight hours a day is estimated at $912 annually. The capital cost for the VFDs is $45,000. The total estimated cost of energy efficient upgrades is $325,177 with the overall cost of the construction being $382,654 (source: http://www.mde.state.md.us/programs/Water/QualityFinancing/Documents/Business%20Case%20Jan%202012.pdf).

Western Virginia Water Authority

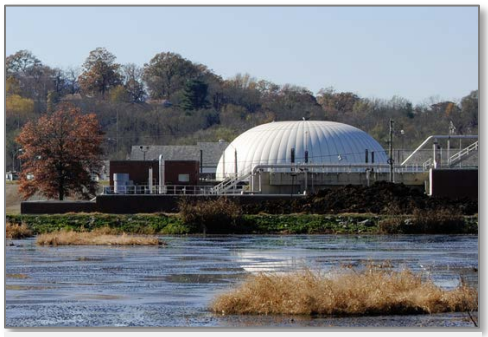
Roanoke, VA

158,000 DW and 120,000 WW customers
(Website: www.westernvawater.org; phone: 540-853-5700)

Mitigation: Reduce energy use by using a CHP system running on waste methane

In 2012, the Western Virginia Water Authority installed two 500 kW generators designed to run on waste methane produced at the Roanoke Regional Water Pollution Control Plant.

A CHP system is used to supply thermal energy to heat the existing digesters and create electrical power that will be used by the plant to reduce its electricity usage. Also, excess heat produced by the system is used to supply thermal energy to absorption chillers to heat and cool the buildings, further reducing electricity costs.



Western Virginia Water Authority Digester Gas Holder for methane.

The CHP generation system offsets approximately 7,577 MW hours of electrical power annually. Depending upon facility flows the generation capacity can cover approximately 30% to 50% of the plant's energy usage. The system is estimated to reduce GHGs by 4,600 metric tons annually. The project's total cost of almost $3 million is expected to pay for itself in seven years. The project was funded in part by a $500,000 grant from the Virginia Department of Mines, Minerals and Energy (source: http://www.westernvawater.org/85256A8D0062C8D5/vwFilesByName/WVWANewsAndPublicDocuments/$File/co-gendedication4-2012.pdf).

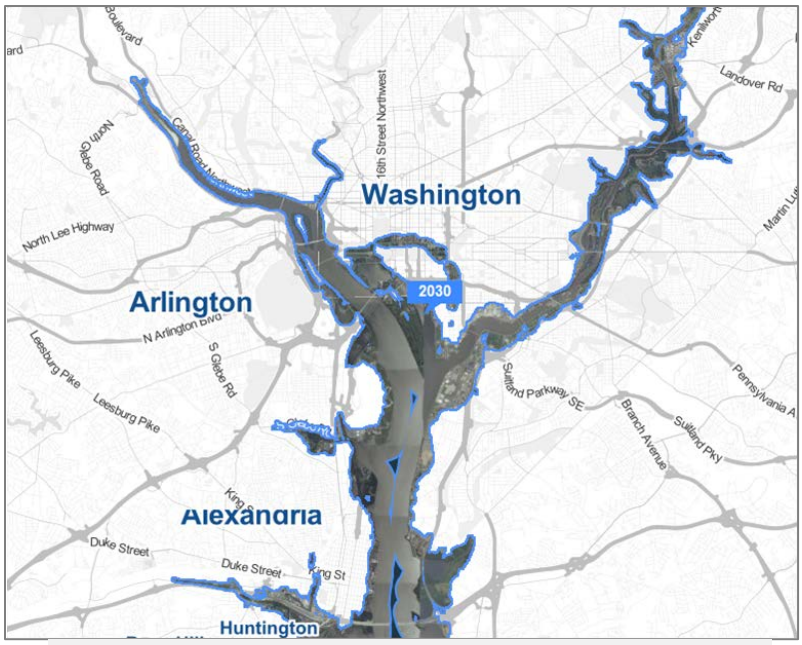
DC Water

Washington, DC

600,000 DW and 600,000 WW customers;
Additional 1.6 million customers from Maryland and Virginia
(Website: http://www.dcwater.com; phone: 202-787-2000)

Mitigation: Implementation of onsite renewable energy technologies
Adaptation: Use of green and traditional or grey infrastructure techniques to reduce impacts from flooding events.

Washington D.C.'s metro region is already experiencing impacts from climate change including warmer temperatures, extreme weather events, and flooding. In particular, the tidal wetland area surrounding the National Mall is particularly vulnerable to flooding from two major rivers, the Potomac and Anacostia, and numerous creeks, streams and springs that flow into the area. Limited sewer capacity to accommodate flooding is also of concern.



Map of projected flood water inundation – showing 10 ft sea level rise at 2030. Source: Analysis by Climate Central

In light of these current and projected impacts, DC Water has implemented a number of mitigation and adaptation projects. For example, DC Water is in the process of constructing a thermal hydrolysis and anaerobic digestion facility. The thermal hydrolysis process will use the solids left over after wastewater treatment to produce a combined 13 mega watt (MW) of heat and power electricity. The implementation of this process will save DC Water $10 million annually, and because DC Water is the largest electricity consumer in the city, grid demand will be reduced by one third. In addition to utilizing onsite renewable energy technologies, DC Water has many mechanisms in place already to adapt to extreme weather events and climate change. For example, DC Water's Blue Plains Advanced WWTP is currently constructed to withstand 100-year flood elevation levels along most of the shoreline and constructed roadways. The plant also boasts a seawall at its south end which was designed to withstand 500-year flood elevation levels.

DC Water is also employing green infrastructure (GI) as a stormwater management technique, with plans to design and construct GI measures such as green roofs, rain gardens, rain barrels, and pervious pavement. Additional GI strategies may also include removing impervious surfaces and using other natural means to capture and infiltrate rain water in the Potomac and Rock Creek drainage areas of the city. DC Water is also implementing its Clean Rivers Project, which consists of a system of tunnels and diversion sewers designed to capture water for treatment at the Blue Plains Advanced WWTP and avoid combined sewer overflows (CSOs). The Clean Rivers Project will reduce CSOs annually by 96 percent throughout the system and by 98 percent for the Anacostia River alone. Additional storage will be added as tunnels in the Northeast Boundary and Branch Tunnel system (NEBBT) are completed. The NEBBT will provide additional storage for CSOs and will relieve street and basement flooding in the Northeast Boundary area of the city.

Loudoun Water

Loudon, VA

200,000 DW and WW customers

(Website: http://www.loudounwater.org/; phone: 571-291-7700)

Adaptation: Integrated water resources planning and water conservation and demand management

Loudoun Water provides water, wastewater, and reclaimed water services for the Central Service Area in Loudoun County, VA. Population growth projections indicate that Loudoun County will experience a 50% growth by 2040 – from approximately 200,000 to 300,000 people. Considering these population projections, meeting customer demand will be difficult if water resources are not managed effectively. To accommodate the expected increase in population and projected changes in extreme weather and climate, Loudoun Water is implementing proactive policies for integrated water resources planning and water conservation/demand management, such as a "water banking" program that stores Potomac River raw water in retired rock quarries and withdraws from the quarries during low flow or poor water quality conditions. Water is deposited to the quarries during normal river flow with no impacts on downstream river users.

"Water banking" program in abandoned rock quarries (left) and reclaimed water pipe, also known as "purple pipe" (right).

To further reduce stress on water resources, Loudoun Water has constructed reclaimed water mains ("purple pipe") to serve private office buildings. Loudoun Water continues to receive a high level of interest from customers interested in reclaimed water service for irrigation, cooling towers and other non-potable uses, and to meet Leadership in Energy & Environmental Design (LEED) criteria. To assist in constructing and implementing reclaimed water services, Loudoun Water received state funding to implement water reuse infrastructure, including a reclaimed water dispensing station at the Broad Run Water Reclamation Facility. In addition to the water banking program and reclaimed water services, Loudoun Water's Strategic Plan incorporates water demand management to proactively plan, develop, and manage water resources through the implementation of demand management tools such as emergency water ordinances, conservation tier rate structure, new technologies, and customer education.

City of Wilmington, DE

Wilmington, DE
71,000 WW customers
(Website: http://www.ci.wilmington.de.us/government/publicworks; phone: 302-576-3060)

Mitigation: Reduce the City's annual energy and operational costs and CO2 footprint through energy efficiency and renewable energy technologies.

In June 2009, Wilmington, Delaware implemented a two-phased approach to reduce annual energy and operational costs and reduce GHG emissions in accordance with the U.S. Conference of Mayors Climate Protection Agreement and Mayor's Executive Order 2008-4. To begin this project, the City entered into a guaranteed energy performance contract (GEPC) with Honeywell to assist with the management and implementation of sustainable energy technologies. The GEPC ensures that the city will have a guaranteed return on investment, all plant and equipment will operate as designed for 20 years, and the contractor, Honeywell, will serve as a single point of accountability. The first phase of this project included the implementation of energy efficiency and renewable energy technologies at the WWTP and throughout the City. These technologies include: water pumping peak load shift, LED lighting fixtures and other energy conservation measures, and solar-photovoltaic installations.

Design of Wilmington's Renewable Energy Biosolids Facility

As part of the project's second phase, in June 2012 the City began construction of the Hay Road Wastewater Treatment Plant – a renewable energy biosolids facility. When complete, the new facility will incorporate a number of sustainable energy technologies, including using methane captured from plant digesters and an adjacent landfill to power the plant and employing a thermal drying technology which uses excess heat from electricity generation to reduce the volume of biosolids produced by the plant. The facility, which is the city's largest energy user, could be 100% powered by the renewable energy onsite and achieve an $800,000 reduction in annual energy costs. The facility will reduce GHG gas emissions by 15,700 metric tons per year – equivalent to the annual emissions from 3,078 passenger vehicles, or 36,000 barrels of oil, or CO2 captured by the equivalent of 3,000 acres of forest.

Alexandria Renew Enterprises

Alexandria, VA
350,000 WW customers
(Website: http://alexrenew.com/; phone: 703-549-3381)

Mitigation: Wastewater treatment plant upgrade to include energy efficiency and energy conservation measures.
Adaptation: Analysis of future flood conditions in order to better plan for sea level rise and storm surge and impacts on peak flow capacity.

Located in Alexandria, Virginia, Alexandria Renew Enterprises (AlexRenew) is a 54 MGD wastewater treatment facility that discharges to the Potomac River and Chesapeake Bay. AlexRenew's mission is to produce safe water and exceptional quality biosolids with environmental integrity. In working toward this mission, AlexRenew uses nutrient removal strategies to meet sustainability objectives through the State of the Art Nitrogen Upgrade Program (SANUP). SANUP has multiple areas of focus related to sustainability including: climate change and GHG emissions, energy, stormwater management, materials waste management, site development and natural environment, and community relations.

AlexRenew's Treatment Facility, Alexandria, VA

More specifically, AlexRenew is implementing a variety of mitigation strategies to minimize lifecycle GHG emissions including optimizing biological reactions to decrease the production of GHG, capturing and treating GHG emissions (N_2O), and studying and enabling operational analyzers. To further achieve their sustainability-focused mission, AlexRenew is implementing strategies and mechanisms focused on reducing energy consumption, such as using the methane gas created by bacteria in the plant's digesters, rather than drawing energy from the grid.

AlexRenew generated close to 130 million cubic feet of renewable energy – enough gas to heat 793 homes for a year. In addition, AlexRenew entered into an energy load shedding program and diverted 1,700 kW to help power companies meet peak demand needs. AlexRenew has also been working to evaluate high efficiency blowers and the use of VFDs, mixer gearing, and optimizing the use of recycled water for temperature control. AlexRenew is also investigating power monitoring for major equipment items and potential opportunities to link that equipment with SCADA.

In addition, AlexRenew analyzed future flood conditions to better plan and adapt to peak flow capacity impacts from sea level rise and storm surge. The analysis concluded that modifications to flow capacity alone would not reduce long-term flood risks unless the ultraviolet (UV system) is also modified. AlexRenew's UV system upgrade is underway and the project will weigh and mitigate the impacts of partial disinfection due to sea level rise and/or flooding of the receiving stream.

Town of Snow Hill, Maryland

Snow Hill, MD
2,500 WW customers
(Website: http://www.snowhillmd.com/liveHere/categoryDirectory.cfm; phone: 410-632-2080)

Mitigation: Wastewater treatment plant upgrade to include energy efficiency and energy conservation measures.
Adaptation: Increase operational resiliency and minimize service disruptions during extreme weather events.

The Town of Snow Hill's WWTP Upgrade project incorporated many energy efficiency and energy conservation design measures. These measures provide substantial cost savings on operational expenses, as well as decreased negative environmental impacts. The design includes energy saving alternatives to minimize electrical, chemical, and water resource needs. More specifically, the new treatment plant design included replacement of existing pumps, a water recycling system, air conditioning, heaters, and water heater replacements, as well as the replacement of existing indoor and outdoor lighting fixtures with more energy efficient models.

Snow Hill Wastewater Treatment Facility under Construction

Aging infrastructure in the old treatment plant posed significant threats to operational capability, particularly during extreme weather events. In addition to the energy saving measures, the Town also installed contingency measures which allow the new treatment plant to stay operational under extreme weather conditions. These contingency measures include a design to provide multiple operational scenarios, numerous piping routes for re-directing and by-passing flow during extreme events, and reduced dependencies during operations. Reduced dependencies include minimizing the need for excess electrical power and treatment chemicals and enabling the SCADA system to allow operators to receive alarms to monitor operations both on and offsite. A co-benefit of this project included incorporating necessary equipment and infrastructure to reduce the plant's nitrogen loading to the Chesapeake Bay from 20 mg/l to about 3 mg/l, as well as reducing the phosphorous loading from 6 mg/l to below 0.3 mg/l.

In order to make this upgrade affordable, the small town of Snow Hill sought funding from a variety of sources including but not limited to: Maryland Department of the Environment, U.S. Department of Agriculture, and the Community Development Block Grant program.

Town of La Plata, Maryland

La Plata, MD
9,500 DW and WW customers
(Website: http://www.townoflaplata.org/; phone: 301-934-8421)

Adaptation: Increased water and wastewater service capacity to meet growing demand and to adapt to impacts from extreme weather events.

The Town of La Plata has experienced growth in both population and in land area since 1960. As a result, demand for water and wastewater services has increased. In addition to rising demand, the Town's aging infrastructure is vulnerable to extreme weather events and changes in climate. To alleviate some of these pressures on water resources, La Plata has implemented a variety of adaptation mechanisms, including upgrades to the Town's WWTP and infrastructure, a remote meter-reading system, increased storage tank capacity, and internet-based GIS capabilities to monitor water infrastructure. To increase the capacity of the Town's WWTP, La Plata's upgrades provide additional treatment, storage and redundancy. La Plata is also currently seeking funding to add supplemental equalization tanks. These additional tanks would provide constant flow through the treatment plant and also compensate for periods of peak flow, as well inflow and infiltration.

La Plata Ground-Level Water Storage Tank

During 2009, about 19% of the 326 million gallons of water produced by the Town's wells was lost – meaning that it was treated and distributed but not recorded on consumer bills. If the amount of water lost is reduced to 10 percent, more than 37,000,000 gallons of water could be saved each year. In efforts to better monitor that lost water, La Plata implemented an upgraded remote-meter reading system. A co-benefit to identifying areas where water is lost is a reduction in the amount of water needed from the Lower Patapsco Aquifer. Furthermore, the remote meter-reading system will also reduce the amount of water that needs to be treated, resulting in lower annual electricity use associated with water treatment at the plant.

An additional adaptive measure is the utility's upgraded SCADA system which provides better control of all water infrastructure. La Plata's SCADA integration with their GIS system shows all water, sewer and stormwater pipes and structures. The locations of the Town's infrastructure were verified by GPS and on site review. The GIS website also offers the utility the ability to view system profiles and plans via the Internet, in addition to providing accurate and detailed data for planning, analysis and maintenance of La Plata's system by offering real time information, including data on usage, leaks, and treatment systems. To fund these upgrades and increase resiliency, La Plata leveraged a variety of funding sources, including state green project funds and disaster recovery grants to help upgrade the Town's water and wastewater infrastructure.